Claims

1. A magnetic sector mass spectrometer comprising:

a magnetic sector mass analyser;

a collector slit arranged downstream of said magnetic sector mass analyser;

a device arranged downstream of said collector slit for dividing an ion beam transmitted through said collector slit into at least a first ion beam and a second ion beam;

a first detector for measuring the intensity of at least a portion of said first ion beam; and

a second detector for measuring the intensity of at least a portion of said second ion beam.

2. A magnetic sector mass spectrometer as claimed in claim 1, wherein said ion beam has a first direction and a second orthogonal direction.

3. A magnetic sector mass spectrometer as claimed in claim 2, wherein ions in said ion beam are dispersed according to their mass to charge ratio in said first direction so that the mass to charge ratio of ions in said ion beam varies along said first direction.

4. A magnetic sector mass spectrometer as claimed in claim 2 or 3, wherein ions in said ion beam are substantially not dispersed according to their mass to charge ratio in said second direction so that the mass

to charge ratio of ions in said ion beam is substantially constant along said second direction.

5. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein, in use, said first and second detectors measure the intensities of at least a portion of said first and second ion beams at substantially the same time.

6. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said magnetic sector mass spectrometer comprises a single focusing magnetic sector mass spectrometer.

7. A magnetic sector mass spectrometer as claimed in any of claims 1-5, wherein said magnetic sector mass spectrometer comprises a double focussing magnetic sector mass spectrometer.

8. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said device comprises an electrode which causes ions to be reflected or deflected onto said first and second detectors.

9. A magnetic sector mass spectrometer as claimed in claim 8, wherein said electrode comprises a finely edged blade.

10. A magnetic sector mass spectrometer as claimed in claim 8 or 9, wherein said electrode comprises a wedge shaped electrode.

11. A magnetic sector mass spectrometer as claimed in claim 8, 9 or 10, wherein said electrode comprises an edge and wherein, in use, analyte ions in said ion beam approaching said edge are arranged so that they are disposed substantially uniformly and/or symmetrically relative to said edge.

12. A magnetic sector mass spectrometer as claimed in any of claims 8-11, wherein said electrode comprises an edge and wherein, in use, interference ions in said ion beam approaching said edge are arranged so that they are disposed substantially non-uniformly and/or asymmetrically relative to said edge.

13. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising an Electron Impact ("EI") ion source.

14. A magnetic sector mass spectrometer as claimed in any of claims 1-12, further comprising a Chemical Ionisation ("CI") ion source.

15. A magnetic sector mass spectrometer as claimed in any of claims 1-12, further comprising an ion source selected from the group consisting of: (i) an Electrospray ("ESI") ion source; (ii) an Atmospheric Pressure Chemical Ionisation ("APCI") ion source; (iii) an Atmospheric Pressure Photo Ionisation ("APPI") ion source; (iv) a Matrix Assisted Laser Desorption Ionisation ("MALDI") ion source; (v) a Laser Desorption Ionisation ("LDI") ion source; (vi) an Inductively Coupled Plasma ("ICP") ion source; (vii) a Fast Atom

Bombardment ("FAB") ion source; (viii) a Liquid Secondary Ions Mass Spectrometry ("LSIMS") ion source; (ix) a Field Ionisation ("FI") ion source; and (x) a Field Desorption ("FD") ion source.

16. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising a continuous ion source.

17. A magnetic sector mass spectrometer as claimed in any of claims 1-15, further comprising a pulsed ion source.

18. A magnetic sector mass spectrometer as claimed in any of claims 13-17, wherein, in use, a voltage difference is maintained between said device and said ion source selected from the group consisting of: (i) 0-100 V; (ii) 100-200 V; (iii) 200-300 V; (iv) 300-400 V; (v) 400-500 V; (vi) 500-600 V; (vii) 600-700 V; (viii) 700-800 V; (ix) 800-900 V; (x) 900-1000 V; and (xi) > 1000 V.

19. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising a processor, said processor determining, in use, the intensity of at least a portion of said first ion beam relative to the intensity of at least a portion of said second ion beam.

20. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein if the intensity of at least a portion of said first ion beam differs from the intensity of at least a portion of said second ion beam

by ≥ x %, then a determination is made that said ion beam includes a significant proportion of interference ions, wherein x is selected from the group consisting of: (i) 1; (ii) 2; (iii) 3; (iv) 4; (v) 5; (vi) 6; (vii) 7; (viii) 8; (ix) 9; (x) 10; (xi) 15; (xii) 20; (xiii) 25; (xiv) 30; (xv) 35; (xvi) 40; (xvii) 45; (xviii) 50; (xix) 55; (xx) 60; (xxi) 65; (xxii) 70; (xxiii) 75; (xxiv) 80; (xxv) 85; (xxvi) 90; (xxvii) 95; (xxviii) 100; and (xxix) > 100.

21. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein if the intensity of at least a portion of said second ion beam differs from the intensity of at least a portion of said first ion beam by ≥ x %, then a determination is made that said ion beam includes a significant proportion of interference ions, wherein x is selected from the group consisting of: (i) 1; (ii) 2; (iii) 3; (iv) 4; (v) 5; (vi) 6; (vii) 7; (viii) 8; (ix) 9; (x) 10; (xi) 15; (xii) 20; (xiii) 25; (xiv) 30; (xv) 35; (xvi) 40; (xvii) 45; (xviii) 50; (xix) 55; (xx) 60; (xxi) 65; (xxii) 70; (xxiii) 75; (xxiv) 80; (xxv) 85; (xxvi) 90; (xxvii) 95; (xxviii) 100; and (xxix) > 100.

22. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein if within a time t the number of ions detected by said first detector differs from the number of ions detected by said second detector by ≥ y standard deviations of the total number of ions detected by said first and second detectors during said time t, then a determination is made that said ion beam includes a significant proportion of interference ions,

wherein y is selected from the group consisting of: (i) 0.25; (ii) 0.5; (iii) 0.75; (iv) 1.0; (v) 1.25; (vi) 1.5; (vii) 1.75; (viii) 2.0; (ix) 2.25; (x) 2.5; (xi) 2.75; (xii) 3.0; (xiii) 3.25; (xiv) 3.5; (xv) 3.75; (xvi) 4.0; and (xvii) >4.0.

23. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein signals from said first and second detectors are summed to produce a combined signal and wherein said combined signal is multiplied by a weighting factor.

24. A magnetic sector mass spectrometer as claimed in claim 23, wherein said weighting factor:

(i) does not substantially attenuate said combined signal when the signal from said first detector substantially equals the signal from said second detector; and/or

(ii) substantially attenuates said combined signal when the signal from said first detector substantially differs from the signal from said second detector.

25. A magnetic sector mass spectrometer as claimed in claim 23 or 24, wherein said weighting factor is of the form $\exp(-ky^n)$ wherein k and n are constants and wherein within a time t the number of ions detected by said first detector differs from the number of ions detected by said second detector by y standard deviations of the total number of ions detected by said first and second detectors during said time t.

26. A magnetic sector mass spectrometer as claimed in claim 25, wherein k is selected from the group consisting of: (i) 0.5-2.0; (ii) 0.6-1.8; (iii) 0.7-1.6; (iv) 0.8-1.4; (v) 0.9-1.2; (vi) 0.95-1.1; and (vii) 1.

27. A magnetic sector mass spectrometer as claimed in claim 25 or 26, wherein n is selected from the group consisting of: (i) 1.0-3.0; (ii) 1.2-2.8; (iii) 1.4-2.6; (iv) 1.6-2.4; (v) 1.8-2.2; (vi) 1.9-2.1; and (vii) 2.

28. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein if a determination is made that said ion beam includes a significant proportion of interference ions then signals from said first and/or said second detectors are discarded or are otherwise deemed to be relatively inaccurate.

29. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein if a determination is made that said ion beam does not include a significant proportion of interference ions then signals from said first and second detectors are summed or are otherwise deemed to be relatively accurate.

30. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising a lens arranged downstream of said collector slit.

31. A magnetic sector mass spectrometer as claimed in claim 30, wherein said lens refocuses the image of said collector slit onto said device.

32. A magnetic sector mass spectrometer as claimed in claim 30, wherein said lens substantially collimates said ion beam.

33. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising a screening tube for guiding ions onto said device.

34. A magnetic sector mass spectrometer as claimed in claim 33, wherein said screening tube is arranged between said collector slit and said device.

35. A magnetic sector mass spectrometer as claimed in claim 33 or 34, wherein said screening tube shields said ion beam from voltages applied to said first and/or said second detector.

36. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said first detector comprises one, two, three, four, five, six, seven, eight, nine, ten or more than ten microchannel plate detectors.

37. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said first detector comprises one, two, three, four, five, six, seven, eight, nine, ten or more than ten conversion dynode(s) for generating electrons in response to ions impinging upon said conversion dynode(s).

38. A magnetic sector mass spectrometer as claimed in claim 37, further comprising one or more electron

multipliers and/or one or more microchannel plate detectors for detecting electrons generated by said conversion dynode(s).

39. A magnetic sector mass spectrometer as claimed in claim 37, further comprising one or more scintillators and/or one or more phosphers upon which electrons generated by said conversion dynode(s) are received in use and wherein said one or more scintilators and/or said one or more phosphers generate photons in response to receiving electrons.

40. A magnetic sector mass spectrometer as claimed in claim 39, further comprising one or more photo-multiplier tubes and/or one or more photo-sensitive solid state detectors for detecting said photons.

41. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said second detector comprises one, two, three, four, five, six, seven, eight, nine, ten or more than ten microchannel plate detectors.

42. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said second detector comprises one, two, three, four, five, six, seven, eight, nine, ten or more than ten conversion dynode(s) for generating electrons in response to ions impinging upon said conversion dynode(s).

43. A magnetic sector mass spectrometer as claimed in claim 42, further comprising one or more electron

multipliers and/or one or more microchannel plate detectors for detecting electrons generated by said conversion dynode(s).

44. A magnetic sector mass spectrometer as claimed in claim 42, further comprising one or more scintillators and/or one or more phosphers upon which electrons generated by said conversion dynode(s) are received in use and wherein said one or more scintilators and/or said one or more phosphers generate photons in response to receiving electrons.

45. A magnetic sector mass spectrometer as claimed in claim 44, further comprising one or more photo-multiplier tubes and/or one or more photo-sensitive solid state detectors for detecting said photons.

46. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising an additional detector arranged upstream of said first and second detectors.

47. A magnetic sector mass spectrometer as claimed in claim 46, wherein said additional detector comprises a conversion dynode.

48. A magnetic sector mass spectrometer as claimed in claim 47, wherein in a mode of operation at least a portion of an ion beam is deflected onto said conversion dynode and wherein said conversion dynode generates electrons in response thereto.

49. A magnetic sector mass spectrometer as claimed in claim 48, further comprising one or more electron multipliers and/or one or more microchannel plate detectors for receiving electrons generated by said conversion dynode.

50. A magnetic sector mass spectrometer as claimed in claim 48, further comprising one or more scintillators and/or one or more phosphers upon which electrons generated by said conversion dynode are received in use and wherein said one or more scintillators and/or said one or more phosphers generate photons in response to receiving electrons.

51. A magnetic sector mass spectrometer as claimed in claim 50, further comprising one or more photo-multiplier tubes and/or one or more photo-sensitive solid state detectors for detecting said photons.

52. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein the gain of said first and/or said second detector can be independently adjusted.

53. A magnetic sector mass spectrometer as claimed in claim 52, wherein said first and second detectors are powered by independently adjustable power supplies.

54. A magnetic sector mass spectrometer as claimed in any preceding claim, wherein said first and second detectors further comprise one or more Analogue to

Digital Converters and/or one or more ion counting detectors.

55. A magnetic sector mass spectrometer as claimed in any preceding claim, further comprising adjustment means for centering said ion beam on to said device.

56. A magnetic sector mass spectrometer as claimed in claim 55, wherein said adjustment means comprises at least one deflecting electrode downstream of said collector slit, said deflecting electrode being arranged to move said ion beam relative to said device.

57. A method of mass spectrometry comprising:

transmitting an ion beam through a magnetic sector mass analyser and a collector slit arranged downstream of said magnetic sector mass analyser;

dividing said ion beam downstream of said collector slit into at least a first ion beam and a second ion beam;

measuring the intensity of at least a portion of said first ion beam with a first detector; and

measuring the intensity of at least a portion of said second ion beam with a second detector.

58. A method of mass spectrometry as claimed in claim 57, wherein said ion beam has a first direction and a second orthogonal direction.

59. A method of mass spectrometry as claimed in claim 58, wherein ions in said ion beam are dispersed according to their mass to charge ratio in said first

direction so that the mass to charge ratio of ions in said ion beam varies along said first direction.

60. A method of mass spectrometry as claimed in claim 58 or 59, wherein ions in said ion beam are substantially not dispersed according to their mass to charge ratio in said second direction so that the mass to charge ratio of ions in said ion beam is substantially constant along said second direction.

61. A method of mass spectrometry as claimed in any of claims 57-60, wherein, in use, said first and second detectors measure the intensities of at least a portion of said first and second ion beams at substantially the same time.

62. A method of mass spectrometry as claimed in any of claims 57-61, further comprising determining the intensity of at least a portion of said first ion beam relative to the intensity of at least a portion of said second ion beam.

63. A method of mass spectrometry as claimed in any of claims 57-62, wherein if the intensity of at least a portion of said first ion beam differs from the intensity of at least a portion of said second ion beam by $\geq$ x %, then a determination is made that said ion beam includes a significant proportion of interference ions, wherein x is selected from the group consisting of: (i) 1; (ii) 2; (iii) 3; (iv) 4; (v) 5; (vi) 6; (vii) 7; (viii) 8; (ix) 9; (x) 10; (xi) 15; (xii) 20; (xiii) 25; (xiv) 30; (xv) 35; (xvi) 40; (xvii) 45; (xviii) 50;

(xix) 55; (xx) 60; (xxi) 65; (xxii) 70; (xxiii) 75; (xxiv) 80; (xxv) 85; (xxvi) 90; (xxvii) 95; (xxviii) 100; and (xxix) > 100.

64. A method of mass spectrometry as claimed in any of claims 57-63, wherein if the intensity of at least a portion of said second ion beam differs from the intensity of at least a portion of said first ion beam by ≥ x %, then a determination is made that said ion beam includes a significant proportion of interference ions, wherein x is selected from the group consisting of: (i) 1; (ii) 2; (iii) 3; (iv) 4; (v) 5; (vi) 6; (vii) 7; (viii) 8; (ix) 9; (x) 10; (xi) 15; (xii) 20; (xiii) 25; (xiv) 30; (xv) 35; (xvi) 40; (xvii) 45; (xviii) 50; (xix) 55; (xx) 60; (xxi) 65; (xxii) 70; (xxiii) 75; (xxiv) 80; (xxv) 85; (xxvi) 90; (xxvii) 95; (xxviii) 100; and (xxix) > 100.

65. A method of mass spectrometry as claimed in any of claims 57-64, wherein if within a time t the number of ions detected by said first detector differs from the number of ions detected by said second detector by ≥ y standard deviations of the total number of ions detected by said first and second detectors during said time t, then a determination is made that said ion beam includes a significant proportion of interference ions, wherein y is selected from the group consisting of: (i) 0.25; (ii) 0.5; (iii) 0.75; (iv) 1.0; (v) 1.25; (vi) 1.5; (vii) 1.75; (viii) 2.0; (ix) 2.25; (x) 2.5; (xi) 2.75; (xii) 3.0; (xiii) 3.25; (xiv) 3.5; (xv) 3.75; (xvi) 4.0; and (xvii) >4.0.

66. A method of mass spectrometry as claimed in any of claims 57-65, further comprising:

summing signals from said first and second detectors to produce a combined signal; and

multiplying said combined signal by a weighting factor.

67. A method of mass spectrometry as claimed in claim 66, wherein said weighting factor:

(i) does not substantially attenuate said combined signal when the signal from said first detector substantially equals the signal from said second detector; and/or

(ii) substantially attenuates said combined signal when the signal from said first detector substantially differs from the signal from said second detector.

68. A method of mass spectrometry as claimed in claim 66 or 67, wherein said weighting factor is of the form $\exp(-ky^n)$ wherein k and n are constants and wherein within a time t the number of ions detected by said first detector differs from the number of ions detected by said second detector by y standard deviations of the total number of ions detected by said first and second detectors during said time t.

69. A method of mass spectrometry as claimed in claim 68, wherein k is selected from the group consisting of: (i) 0.5-2.0; (ii) 0.6-1.8; (iii) 0.7-1.6; (iv) 0.8-1.4; (v) 0.9-1.2; (vi) 0.95-1.1; and (vii) 1.

70. A method of mass spectrometry as claimed in claim 68 or 69, wherein n is selected from the group consisting of: (i) 1.0-3.0; (ii) 1.2-2.8; (iii) 1.4-2.6; (iv) 1.6-2.4; (v) 1.8-2.2; (vi) 1.9-2.1; and (vii) 2.

71. A method of mass spectrometry as claimed in any of claims 57-70, wherein if a determination is made that said ion beam includes a significant proportion of interference ions then signals from said first and/or said second detectors are discarded or are otherwise deemed to be relatively inaccurate.

72. A method of mass spectrometry as claimed in any of claims 57-71, wherein if a determination is made that said ion beam does not include a significant proportion of interference ions then signals from said first and second detectors are summed or are otherwise deemed to be relatively accurate.